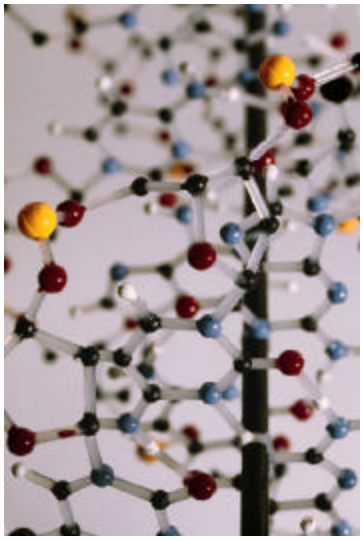
Life Sciences in Missouri:
Agri-Chemical Industry



ECONOMIC SECTOR ANALYSIS

Report ESA-0601-1
June 2001

ECONOMIC SECTOR ANALYSIS
Research and Planning
Missouri Department of Economic Development

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Life Sciences in Missouri: Agri-Chemical Industry

Key Findings

- In 2000, agri-chemical employment was estimated at 4,569, an increase of 24.2% since 1990. Estimated annual average wages per job during 2000 in the agri-chemical industry was $117,584, an increase of 147.0% since 1990. The number of agri-chemical firms in 2000 was estimated at 59, an increase of 59.5% since 1990.

- In 2000, the majority of agri-chemical jobs were located in suburban St. Louis, Kansas City and St. Joseph. Additionally, agri-chemical jobs were also located in several rural areas of the state, such as Hannibal and Bowling Green.

- The agri-chemical industry accounts for 1.06% of Missouri's GSP, which is equivalent to $1.78 billion dollars in 2001.

- The agri-chemical industry accounts for the largest percent of GRP in the Kansas City Metro Region (3.96%), the North East Region (2.38%), the St. Louis Metro Region (1.66%), and the North West Region (1.47%). However, in terms of GRP dollars the agri-chemical industry is largest in the St. Louis Metro Region ($851.5 million), the Kansas City Metro Region ($384.9 million), Kansas City ($142.5 million), and St. Louis ($122.5 million).

- The direct impact of 4,569 jobs in the agri-chemical industry created an additional 21,251 ancillary jobs in Missouri's economy, resulting in a total impact of 25,820 jobs and $1.21 billion in wages across Missouri - which translates into an annual average wage per job of $46,824.

- The St. Louis Metro Region is most positively affected by the agri-chemical industry, accounting for 12,290 jobs (at $57,404 per job) and $705.5 million in wages. In the Kansas City Metro Region, the agri-chemical industry accounts for 4,585 jobs (at $38,430 per job) and $176.2 million wages. In Kansas City, the agri-chemical industry accounts for 2,551 jobs (at $44,884 per job) and $114.5 million wages. Lastly, in St. Louis the agri-chemical industry accounts for 1,834 jobs (at $54,062 per job) and $99.2 million wages.

- The agri-chemical industry supports five main occupational groups in Missouri: Administrative Support and Clerical workers (employing 4,518 people or 17.5% of the agri-chemical labor force); Marketing and Sales workers (employing 3,035 people or 11.8% of the agri-chemical labor force); Service workers (employing 3,033 people or 11.8% of the agri-chemical labor force); Executives and Managers (employing 2,848 people or 11.0% of the agri-chemical labor force); and Professional Specialty workers (employing 2,594 people or 10.1% of the agri-chemical labor force).

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I. Overview

Life sciences, commonly referred to as biotechnology, consists of a set of innovations that are revolutionizing health care, food production, and manufacturing. Life sciences is generally defined as the applied knowledge of biology, and it is not a new phenomenon. Throughout history, humans have selected and manipulated the genomes of plants, animals, and even ourselves. Until now, however, such control could be exerted only at the level of the entire organism. Scientific and technological advances now allow humans to manipulate genomes directly at the level of single genes and their constituents, with a speed and precision that far exceed what natural evolution has been able to achieve over the past 3.5 billion years[1]. Scientific advances made in the mid-20th century laid the foundation for rapid growth in life sciences in the 1990s. Since the modern life sciences industry is relatively new, one can still distinguish companies that specialize in pharmaceutical, agricultural and industrial products[2].

Life sciences is designated as one of Missouri's targeted industries for economic development and growth, and is actively supported by the Office of the Governor and various state agencies. The Missouri Department of Economic Development is a catalyst promoting synergies and partnerships statewide on behalf of life sciences development. Based on this initiative, Research and Planning has delineated six main life science industries: agri-chemicals, bio-medical, equipment and instruments, food and nutrition, industrial chemicals, and life sciences research. Therefore, this report examines the agri-chemical industry as a subsector of life sciences. The purpose of this analysis is to determine this industry's impact on Missouri's economy.

Research and Planning at the Missouri Department of Economic Development conducts comprehensive analyses of key economic sectors within Missouri's economy. Economic Sector Analyses (ESAs) assist state and local officials in determining the economic importance of a particular industry at the county-level. ESAs are used to: (1) identify which counties have a large concentration of employment and wages in a particular industry; (2) identify which counties have a competitive advantage in a particular industry; (3) identify where firms are located in a particular industry; (4) assess statewide employment and wage impacts of a particular industry in the current year; and (5) forecast statewide employment, wage and tax revenue impacts of a particular industry over 10 years. ESAs use detailed sector data (Covered Employment and Wages, formerly ES-202) to determine employment and wages in a particular industry at the county-level. This flexibility allows for the creation of unique and customized aggregate economic sectors.

[1] Life Sciences: Green and Dying. *The Economist*. 18 November 2000.
[2] Biotech Bonanza. *Federal Reserve Bank of Dallas.* July/August 2000.

II. Methods

The agri-chemical industry in Missouri is analyzed using two methods: specialization ratios and econometric models. Agri-chemical industry employment and wages was obtained from Covered Employment and Wages (formerly ES-202) data, maintained by the Missouri Department of Economic Development.

The agri-chemical industry was defined using an expert-based classification scheme developed by the Missouri Department of Economic Development. Based on a consensus of experts, the following Standard Industry Classifications (SICs) were identified as comprising the agri-chemical industry: nitrogenous fertilizers; phosphatic fertilizers; mixed fertilizers; and pesticides and agricultural chemicals. Refer to Appendix A for a full list of SICs.

Specialization ratios (SRs), also known as location quotients, are used to describe the dispersion of the agri-chemical industry across Missouri. SRs measure a county's employment concentration in a given industry relative to the state average. Comparing these ratios over time gives an indication of the relative strengths and weaknesses of the industry. SRs greater than 1.0 indicate that the county is relatively more specialized in an industry relative to the state as a whole; or that the county has a comparative advantage in that industry. SRs less than 1.0 indicate that the county is less specialized in an industry relative to the state as a whole, which may indicate an area for potential growth; or that the county does not have a comparative advantage in that industry.

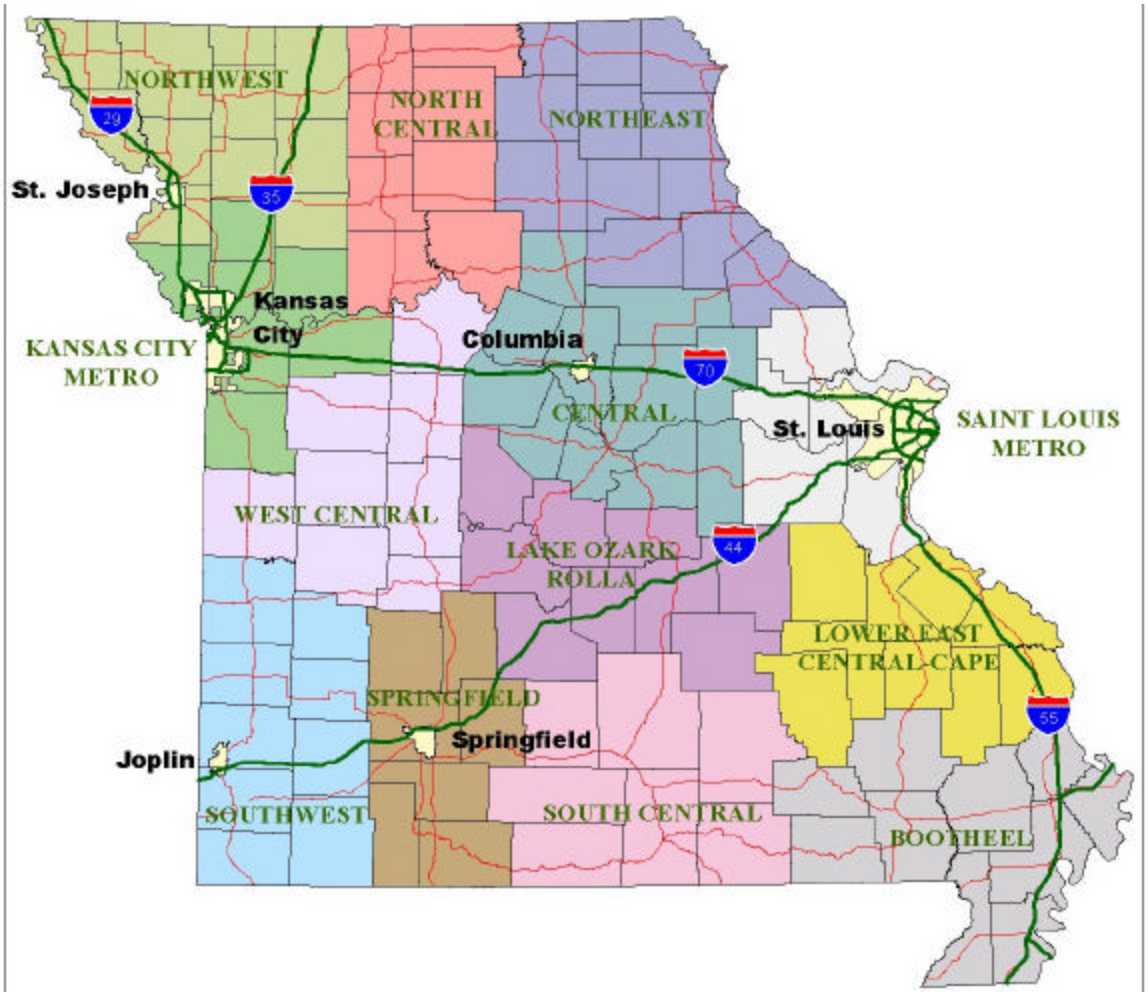
It is important to note that SRs measure the proportion of industry employment relative to the state average, and ***not*** the total number of jobs. Therefore, although St. Louis may have the largest number of employees within the agri-chemical industry, it may account for only a small percentage of total employment – leading to a small SR. It is also important to note that the following SRs are normalized to the Missouri mean. In general, SRs are most informative when normalized to the national mean. However, national data was not available at this level of sector detail.

The formula for a SR is given below:

$$SR_{sec\,tor} = \left(\frac{\left(\frac{SECTOR\_EMPLOYMENT_{county}}{TOTAL\_EMPLOYMENT_{county}} \right)}{\left(\frac{SECTOR\_EMPLOYMENT_{state}}{TOTAL\_EMPLOYMENT_{state}} \right)} \right)$$

The REMI Missouri Multi-Regional **econometric model** is utilized to forecast economic impacts at the regional and state level. REMI is a comprehensive economic forecasting and policy analysis model. The model incorporates a complete economic history of the state and forecasts data specific to Missouri. The model also has thousands of policy variables that can be used to show the effects of a broad range of economic development policies. The dynamic structure of the model provides the capability to evaluate tax and other changes that affect costs as an aspect of these policies. The dynamic properties of the model also show medium and long-term effects, in addition to short-term effects, on the economy of Missouri. Further, REMI is able to forecast economic impacts for Missouri's 15 economic regions. Refer to Map 1.

Map 1
REMI Missouri Multi-Regional Model
Economic Regions



III. Industry Analysis

Industry Trends

Both nationally and in Missouri, the agri-chemical industry has grown over the last decade - especially in terms of wages. Agri-chemical employment in Missouri was estimated at 4,569 in 2000, an increase of 24.2% since 1990. Total annual wages during 2000 in the agri-chemical industry in Missouri was estimated at $537.6 million, an increase of 207.0% since 1990. Estimated annual average wages per job during 2000 in the agri-chemical industry was $117,584, an increase of 147.0% since 1990. The number of agri-chemical firms in Missouri in 2000 was estimated at 59, an increase of 59.5% since 1990.

In 2000, the agri-chemical industry accounted for only 0.2% of total employment and 0.7% of total wages in Missouri. The annual average wage per job during 2000 in the agri-chemical industry was $117,584, well above the state average wage per job of $30,721. Refer to Table 1.

Table 1
Agri-Chemical Economic Indicators, 1990-2000

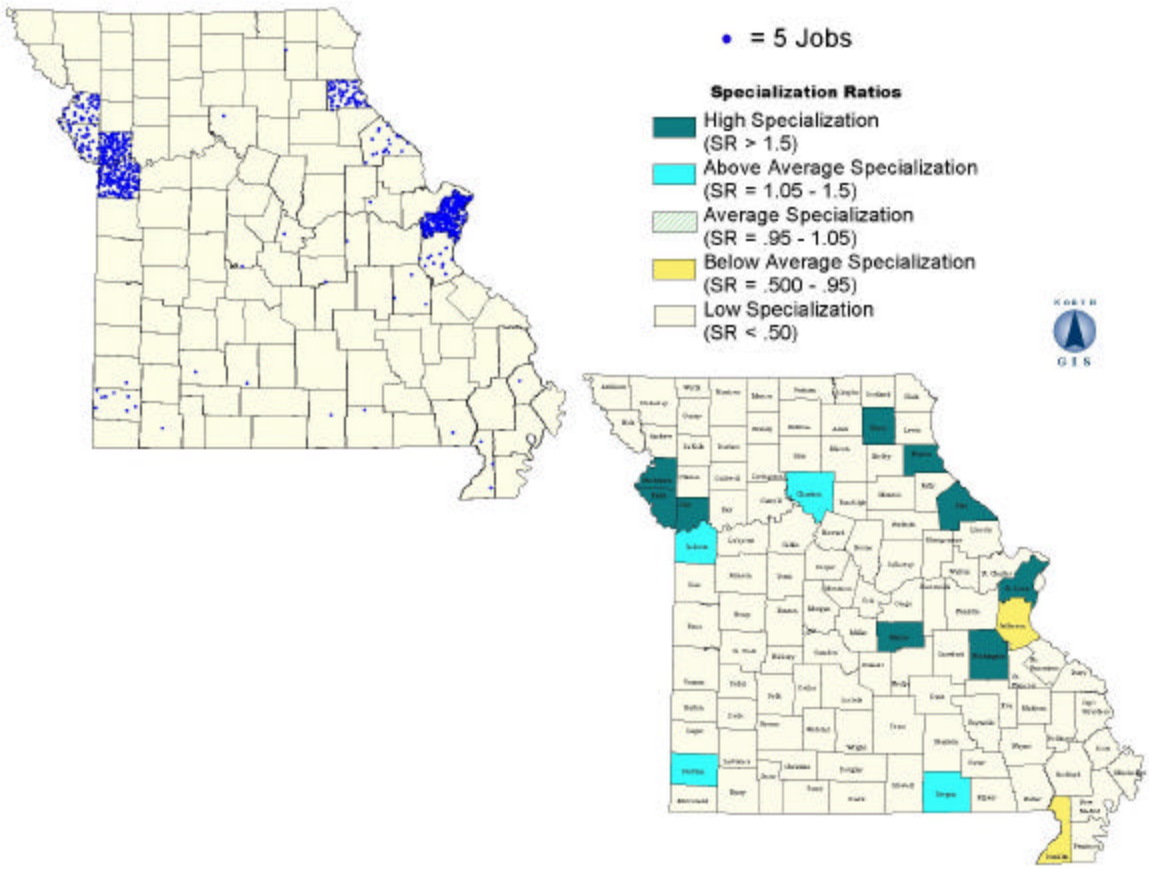
INDICATOR	1990	2000	Percent Change
Total Employment (Percent of Total Missouri Employment)	3,679 (0.2%)	4,569 (0.2%)	24.2% ↑
Total Wages, in Millions of 2000 Dollars (Percent of Total Missouri Wages)	$175.1 (0.3%)	$537.6 (0.7%)	207.0% ↑
Annual Average Wage Per Job, in 2000 Dollars (Missouri Annual Average Wage Per Job)	$47,598 ($28,462)	$117,584 ($30,721)	147.0% ↑
Total Firms	37	59	59.5% ↑

Source: Covered Employment and Wages, Missouri Department of Economic Development.

In 2000, the majority of agri-chemical jobs were located in suburban St. Louis, Kansas City and St. Joseph. Additionally, agri-chemical jobs were also located in several rural areas of the state, such as Hannibal and Bowling Green. Counties with the largest employment base were St. Louis (1,899), Jackson (862), Clay (681), Marion (335), Buchanan (246) and Platte (182).

According to specialization ratios, 9 Missouri counties were highly specialized in agri-chemical employment. These areas were located in several rural areas of the state and in suburban metropolitan areas. The most specialized counties in the state were Marion (13.82), Pike (8.15), Clay (4.65), Knox (3.35), Buchanan (3.30), Platte (3.05), Maries (2.40), Washington (2.10) and St. Louis (1.70). It is important to note that specialization ratios measure the proportion of industry employment relative to the state average, and not the total number of jobs. Refer to Map 2.

Map 2
Agri-Chemical Employment and Specialization, 2000

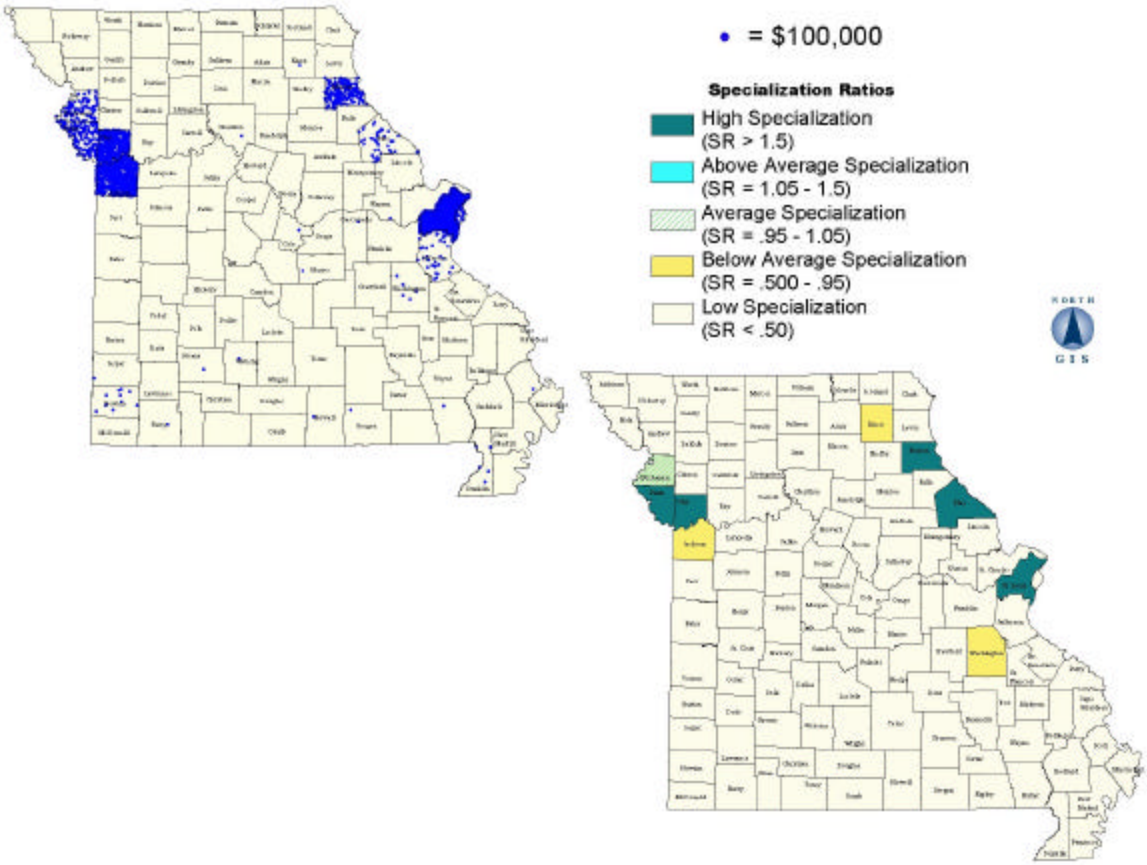


Source: Covered Employment and Wages, Missouri Department of Economic Development.

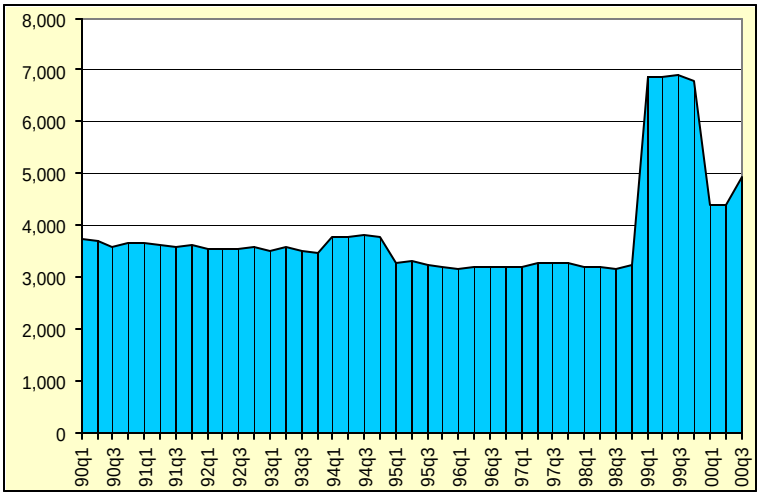
In 2000, the majority of agri-chemical wages were located in suburban St. Louis, Kansas City and St. Joseph. Additionally, agri-chemical wages were also located in several rural areas of the state, such as Hannibal and Bowling Green. Counties with the largest wage base were St. Louis ($370.0 million), Jackson ($68.1 million), Clay ($43.7 million), Marion ($19.6 million), Platte ($14.4 million), and Buchanan ($8.2 million).

According to specialization ratios, 5 Missouri counties were highly specialized in agri-chemical wages. These areas were located in several rural areas of the state and in suburban metropolitan areas. The most specialized counties in the state were Marion (8.87), Pike (4.54), Clay (2.47), St. Louis (2.30) and Platte (1.99). It is important to note that specialization ratios measure the proportion of industry wages relative to the state average, and not the total number of wages. Refer to Map 3.

Map 3
Agri-Chemical Wages and Specialization, 2000



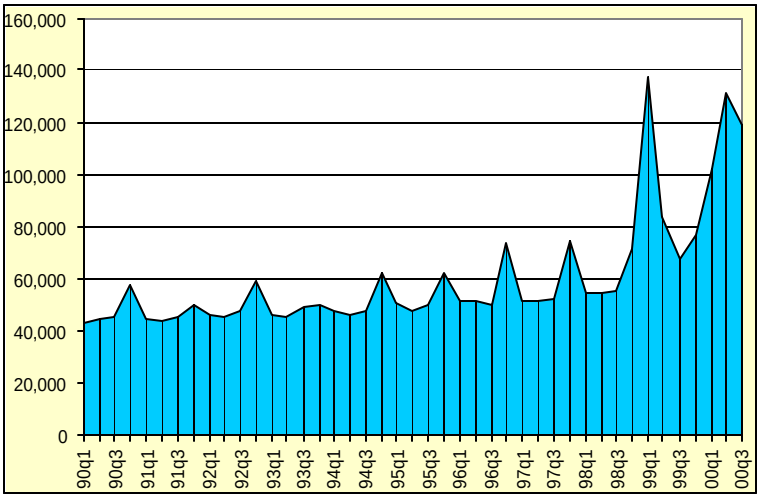
Source: Covered Employment and Wages, Missouri Department of Economic Development.



Source: Covered Employment and Wages, Missouri Dept of Economic Development.

Employment by Quarter, 1990-2000

Agri-chemical employment in Missouri has remained fairly steady through the last decade, with significant increases during 1999. The most current data estimates 4,929 agri-chemical jobs during 3d quarter 2000. Employment was highest during 3rd quarter 1999, with 6,915 jobs. In fact, employment levels were significantly higher during all of 1999. Employment was lowest during 3rd quarter 1998, with 3,172 jobs.

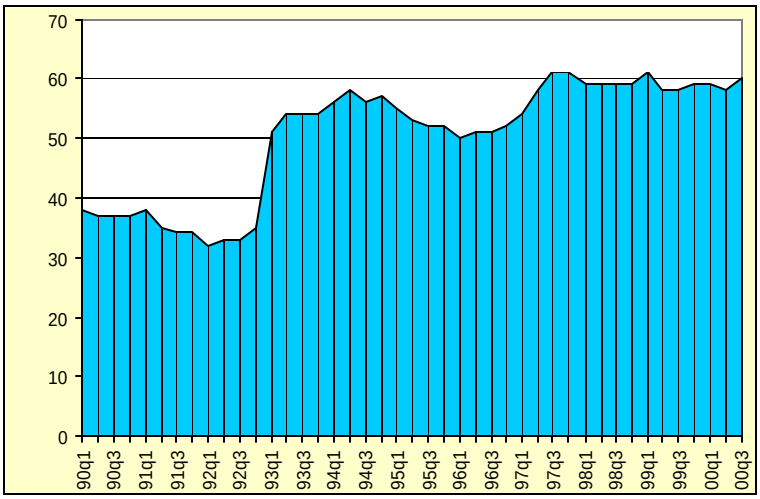


Source: Covered Employment and Wages, Missouri Dept of Economic Development.

Annual Average Wages Per Job by Quarter, 1990-2000

Annual average wages per job in the agri-chemical industry in Missouri has substantially increased since 1990. The most current data estimates an astounding average wage per job of $119,271 during 3rd quarter 2000 - significantly higher than the state average wage of $30,497. Average wages per job were highest during 1st quarter 1999, at $137,713 per job. Average wages per job were lowest during 1st quarter 1990, at $42,828 per job.

Adjusted to 2000 Real Dollars.
Quarter Wages Annualized.



Source: Covered Employment and Wages, Missouri Dept of Economic Development.

Number of Firms by Quarter, 1990-2000

The number of agri-chemical firms in Missouri has increased steadily since 1990 - with fast growth during 1993. After a rise in 1997, firm numbers have remained fairly steady. The most current data estimates 60 agri-chemical firms during 3rd quarter 2000. Firms were most numerous during the last half of 1997 and during 1st quarter 1999, at 61 establishments. Firms were least numerous during 1st quarter 1992, at 32 establishments.

Gross Regional/State Product

Gross state product (GSP) and gross regional product (GRP) for each state/region is derived as the sum of the gross state/regional product originating in all industries in the state/region. In concept, an industry's GSP/GRP, or its value added, is equal to its gross output (sales or receipts and other operating income, commodity taxes, and inventory change) minus its intermediate inputs (consumption of goods and services purchased from other U.S. industries or imported). Thus, GSP/GRP is often considered the state/regional counterpart of the national gross domestic product (GDP).

The agri-chemical industry accounts for 1.06% of Missouri's GSP, which is equivalent to $1.78 billion dollars in 2001. The agri-chemical industry accounts for the largest percent of GRP in the Kansas City Metro Region (3.96%), the North East Region (2.38%), the St. Louis Metro Region (1.66%), and the North West Region (1.47%). However, in terms of GRP dollars the agri-chemical industry is largest in the St. Louis Metro Region ($851.5 million), the Kansas City Metro Region ($384.9 million), Kansas City ($142.5 million), and St. Louis ($122.5 million). Refer to Table 2.

Table 2
Agri-Chemical Gross Regional/State Product, 2001
Difference from baseline projection.
Numbers may not sum due to rounding.

	GROSS REGIONAL/STATE PRODUCT	
REGION	Percent	Dollar Value
Bootheel	0.30%	$12,950,000
Central	0.27%	$26,170,000
Kansas City	0.56%	$142,500,000
Kansas City Metro	3.96%	$384,900,000
Lake Ozark - Rolla	0.25%	$11,980,000
Lower East Central / Cape Girardeau	0.41%	$19,620,000
North Central	0.30%	$5,270,000
North East	2.38%	$69,670,000
North West	1.47%	$56,790,000
South Central	0.27%	$5,664,000
South West	0.38%	$28,660,000
Springfield	0.26%	$30,100,000
St. Louis	0.70%	$122,500,000
St. Louis Metro	1.66%	$851,500,000
West Central	0.21%	$8,012,000
MISSOURI GSP	**1.06%**	**$1,776,000,000**

Source: REMI Analysis by Research and Planning, MO Department of Economic Development

Employment and Wages

The agri-chemical industry has a significant impact on Missouri's employment base. In 2001, the agri-chemical industry employed 4,569 people earning $537.6 million in wages - which translates into an annual wage per job of $117,584. This direct employment in the agri-chemical industry created an additional 21,251 ancillary jobs in Missouri's economy, resulting in a total impact of 25,820 jobs and $1.21 billion in wages across Missouri - which translates into an annual average wage per job of $46,824.

Both directly and indirectly, the agri-chemical industry has the greatest impact on the Services sector, accounting for 7,009 jobs (at $33,129 per job) and $232.2 million in wages. In the Non-Durable Manufacturing sector, the agri-chemical industry accounts for 4,873 jobs (at $108,106 per job) and $526.8 million in wages. In the Retail Trade sector, the agri-chemical industry accounts for 4,390 jobs (at $17,216 per job) and $75.6 million in wages. In the Construction sector, the agri-chemical industry accounts for 3,154 jobs (at $32,689 per job) and $103.1 million in wages. It appears that the Agriculture/Forestry/Fishing, Government and Mining sectors are marginally impacted by the agri-chemical industry.

In terms of average wage per job, the agri-chemical industry has the greatest impact on the Non-Durable Manufacturing sector, accounting for 4,873 jobs at $108,106 per job. In Durable Manufacturing, the agri-chemical industry accounts for 764.6 jobs at $62,189 per job. In Wholesale Trade, the agri-chemical industry accounts for 1,638 jobs at $49,426 per job. Lastly, in Transportation, Communications and Public Utilities the agri-chemical industry accounts for 1,545 jobs at $43,191 per job. Refer to Table 3.

Table 3
Agri-Chemical Employment and Wages by Sector, 2001
Difference from baseline projection.
Numbers may not sum due to rounding.

SECTOR	EMPLOYMENT	WAGES	WAGE PER JOB
Agriculture, Forestry, Fishing	186.8	$2,504,000.0	$13,404.71
Construction	3,154.0	$103,100,000.0	$32,688.65
Finance, Insur and Real Estate	1,348.0	$55,870,000.0	$41,446.59
Government	358.1	-	-
Manufacturing - Durable	764.6	$47,550,000.0	$62,189.38
Manufacturing - Non-Durable	4,873.0	$526,800,000.0	$108,105.89
Mining	551.3	$17,610,000.0	$31,942.68
Services	7,009.0	$232,200,000.0	$33,128.83
Trade - Retail	4,390.0	$75,580,000.0	$17,216.40
Trade - Wholesale	1,638.0	$80,960,000.0	$49,426.13
Transport, Comm. & Public Utilities	1,545.0	$66,730,000.0	$43,190.94
TOTAL	**25,820.0**	**$1,209,000,000.0**	**$46,824.17**

Source: REMI Analysis by Research and Planning, MO Department of Economic Development

The agri-chemical industry also has positive economic impacts within the regional economies of Missouri as well. In 2001, the direct employment of 4,569 jobs in the agri-chemical industry results in the creation of 21,251 ancillary jobs in the state economy - resulting in a total impact of 25,820 jobs and $1.21 billion in wages across Missouri.

The St. Louis Metro Region is most positively affected by the agri-chemical industry, accounting for 12,290 jobs (at $57,404 per job) and $705.5 million in wages. In the Kansas City Metro Region, the agri-chemical industry accounts for 4,585 jobs (at $38,430 per job) and $176.2 million wages. In Kansas City, the agri-chemical industry accounts for 2,551 jobs (at $44,884 per job) and $114.5 million wages. Lastly, in St. Louis the agri-chemical industry accounts for 1,834 jobs (at $54,062 per job) and $99.2 million wages.

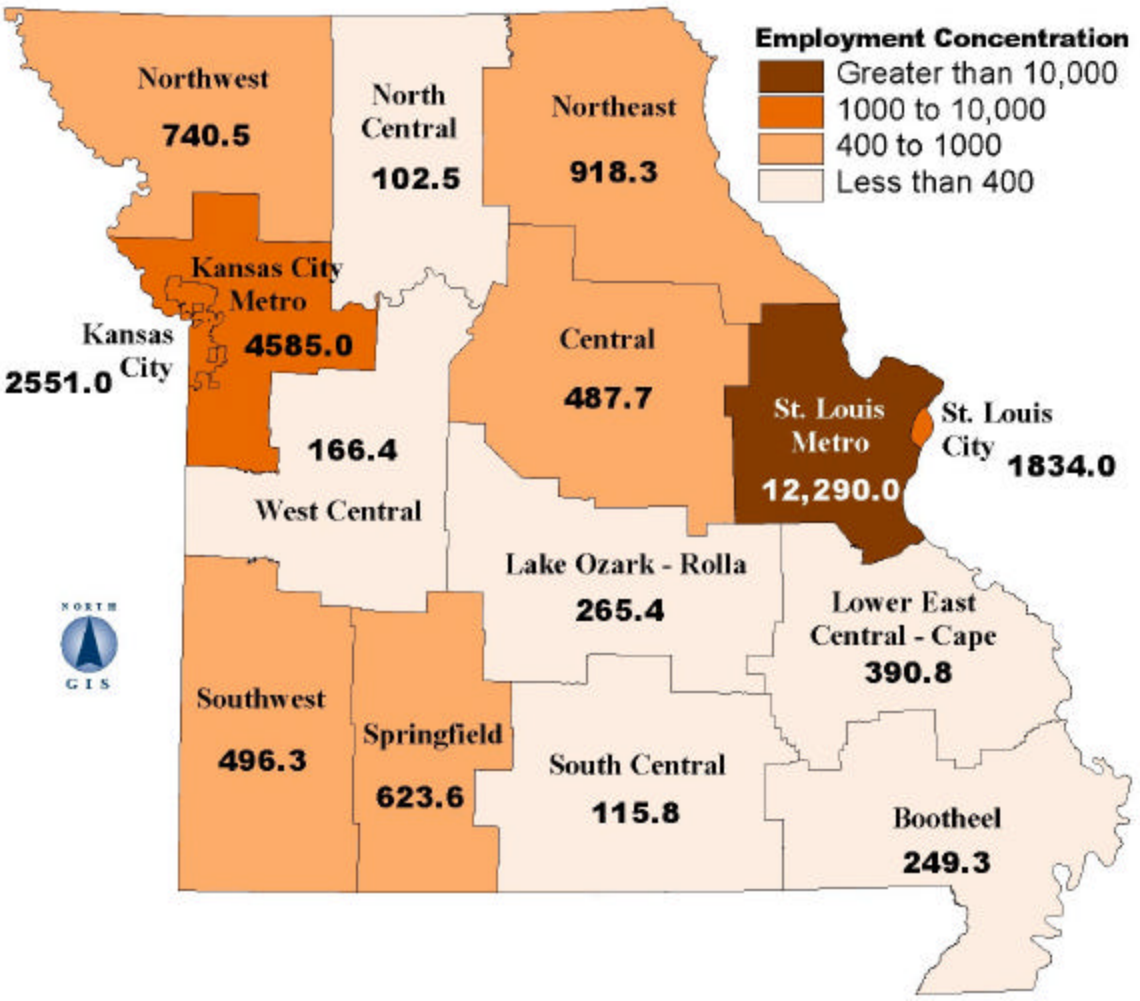
In general, most other regions in the state are only moderately or marginally impacted by the agri-chemical industry. Refer to Table 4 and Map 4.

Table 4
Agri-Chemical Employment and Wages by Region, 2001
Difference from baseline projection.
Numbers may not sum due to rounding.

REGION	EMPLOYMENT	WAGES	WAGE PER JOB
Bootheel	249.3	$5,300,000.0	$21,259.53
Central	487.7	$12,880,000.0	$26,409.68
Kansas City	2,551.0	$114,500,000.0	$44,884.36
Kansas City Metro	4,585.0	$176,200,000.0	$38,429.66
Lake Ozark - Rolla	265.4	$5,189,000.0	$19,551.62
Lower East Central / Cape Girardeau	390.8	$10,590,000.0	$27,098.26
North Central	102.5	$1,917,000.0	$18,702.44
North East	918.3	$28,330,000.0	$30,850.48
North West	740.5	$16,580,000.0	$22,390.28
South Central	115.8	$1,934,000.0	$16,701.21
South West	496.3	$11,410,000.0	$22,990.13
Springfield	623.6	$15,630,000.0	$25,064.14
St. Louis	1,834.0	$99,150,000.0	$54,062.16
St. Louis Metro	12,290.0	$705,500,000.0	$57,404.39
West Central	166.4	$3,720,000.0	$22,355.77
MISSOURI	**25,820.0**	**$1,209,000,000.0**	**$46,824.17**

Source: REMI Analysis by Research and Planning, MO Department of Economic Development

Map 4
Agri-Chemical Employment by Region, 2001



Source: REMI Analysis by Research and Planning, MO Department of Economic Development

Occupational Structure

Both directly and indirectly, the agri-chemical industry supports five main occupational groups in Missouri. Administrative Support and Clerical workers comprise the largest occupational group, employing 4,518 people or 17.5% of the agri-chemical labor force. This group includes administrative assistants, clerks and secretaries. Marketing and Sales workers comprise the second largest occupational group, employing 3,035 people or 11.8% of the agri-chemical labor force. This group includes finance, marketing and sales workers. Service workers comprise the third largest occupational group, employing 3,033 people or 11.8% of the agri-chemical labor force. This group includes food, health, personal and protective service workers. Executives and Managers comprise the fourth largest occupational group, employing 2,848 people or 11.0% of the agri-chemical labor force. This group includes managers and managerial support professionals. Lastly, Professional Specialty workers comprise the fifth largest occupational group, employing 2,594 people or 10.1% of the agri-chemical labor force. This group includes engineers, life scientists, physical scientists and social scientists. Refer to Table 5.

Table 5
Agri-Chemical Occupational Structure, 2001
Difference from baseline projection.
Numbers may not sum due to rounding.

OCCUPATION	EMPLOYMENT	PERCENT AGRI-CHEMICAL EMPLOYMENT	PERCENT MISSOURI EMPLOYMENT
Administrative Support & Clerical	4,517.5	17.50%	7.32%
Agric, Forestry, Fishing	267.5	1.04%	1.74%
Blue Collar Worker Supervisors	578.1	2.24%	1.30%
Construction Trades	1,372.0	5.31%	1.55%
Executive, Managerial	2,848.3	11.03%	1.73%
Extractive Workers	124.7	0.48%	22.11%
Hand Workers, Assembly, Fabrication	374.1	1.45%	0.54%
Laborers, Material Movers	1,472.0	5.70%	1.06%
Machine Operators & Setters	1,340.3	5.19%	5.91%
Marketing, Sales	3,035.3	11.76%	6.38%
Mechanics, Installers	1,335.9	5.17%	4.26%
Plant & Utility Operators	212.3	0.82%	24.03%
Production - Precision	512.4	1.98%	5.41%
Professional Specialty	2,594.2	10.05%	12.68%
Service	3,033.4	11.75%	4.23%
Technicians	799.2	3.10%	2.39%
Transportation Workers	1,400.6	5.42%	4.75%
TOTAL	**25,820.0**	**100.0%**	**-**

Source: REMI Analysis by Research and Planning, MO Department of Economic Development

IV. Growth/Loss Scenario

In the growth/loss scenario, regional and state impacts are ascertained by examining the difference between the baseline projection (no gain/loss of jobs) and the scenario projection (gain/loss of 100 jobs). The differential indicates the impact above or below what would have been expected if no change in the economy had occurred.

Gross Regional/State Impacts

The gain/loss of 100 jobs in the agri-chemical industry in Missouri would result in a 0.024% increase/decrease in Missouri's gross state product (GSP) in 2001, translating into a $38.9 million dollar GSP gain/loss. By 2011, the impact on GSP remains fairly constant, with a 0.017% or $32.7 million dollar increase/decrease in GSP.

The gain/loss of 100 agri-chemical jobs also impacts gross regional product (GRP) in Missouri. The Kansas City Metro Region would experience the largest impact, resulting in a 0.087% increase/decrease in GRP. The North East Region would experience the second largest impact, resulting in a 0.052% increase/decrease in GRP. Lastly, the St. Louis Metro Region would experience the third largest impact, resulting in a 0.036% increase/decrease in GRP. Refer to Table 6.

Table 6
Projected Gross Regional/State Product Impacts, 2001-2011
Difference from baseline projection per 100 job increase/decrease.
Numbers may not sum due to rounding.

	GROSS REGIONAL/STATE PRODUCT CHANGE		
REGION	2001	2006	2011
Bootheel	0.007%	0.005%	0.004%
Central	0.006%	0.005%	0.004%
Kansas City	0.012%	0.008%	0.007%
Kansas City Metro	0.087%	0.074%	0.064%
Lake Ozark - Rolla	0.005%	0.004%	0.003%
Lower East Central / Cape Girardeau	0.009%	0.007%	0.005%
North Central	0.007%	0.005%	0.004%
North East	0.052%	0.048%	0.043%
North West	0.032%	0.028%	0.026%
South Central	0.006%	0.004%	0.004%
South West	0.008%	0.006%	0.005%
Springfield	0.006%	0.004%	0.003%
St. Louis	0.015%	0.010%	0.009%
St. Louis Metro	0.036%	0.029%	0.025%
West Central	0.005%	0.003%	0.003%
MISSOURI GSP - Percent Change	**0.024%**	**0.019%**	**0.017%**
MISSOURI GSP - Dollar Change	**$38,890,000.0**	**$34,100,000.0**	**$32,710,000.0**

Source: REMI Analysis by Research and Planning, MO Department of Economic Development

Employment and Wage Impacts

As demonstrated above, the gain/loss of 100 agri-chemical jobs would have a moderate economic impact on Missouri's gross state product. However, the industry has a significant impact on employment and wages in Missouri. Regional and state impacts are ascertained by examining the difference between the baseline projection (no gain/loss of jobs) and the scenario projection (gain/loss of 100 jobs). The differential indicates the number of jobs above or below what would have been expected if no change in the economy had occurred.

In 2001, the gain/loss of 100 agri-chemical jobs would result in the gain/loss of 465.4 ancillary jobs in Missouri - for a total gain/loss of 565.4 jobs and $27.3 million in wages across the state. By 2011, the total impact steadily drops to 375.5 jobs and $24.3 million in wages.

The Services sector would be most impacted, resulting in the gain/loss of 153.3 jobs (at $33,222 per job) and $5.1 million wages in 2001. By 2011 the impact steadily drops, with the projected gain/loss of 98 jobs and $4.0 million in wages. This indicates a moderate economic impact, since the average wage per job is moderate. As expected, the Non-Durable Manufacturing sector would also be significantly impacted, resulting in the gain/loss of 106.6 jobs (at an astounding $108,537 per job) and $11.6 million wages in 2001. However, by 2011 the impact decreases moderately, with the projected gain/loss of 84.5 jobs and $12.8 million in wages. This impact is significant in that the number of jobs and the average wage per job is quite high. The Retail Trade sector would also be moderately impacted, resulting in the gain/loss of 96.3 jobs (at $17,227 per job) and $1.7 million wages in 2001. However, by 2011 the impact decreases moderately, with the projected gain/loss of 58.7 jobs and $1.1 million in wages.

It appears that the Agriculture/Forestry/Fishing, Government and Mining sectors are marginally impacted in 2001. However, by 2011 the Government sector experiences a large increase in jobs. This growth is attributable to the increase in population by 2011, which leads to a increased demand for public services. Refer to Tables 7 and 8.

Table 7
Projected Employment Impacts by Sector, 2001-2011
Difference from baseline projection per 100 job increase/decrease.
Numbers may not sum due to rounding.

	EMPLOYMENT CHANGE		
SECTOR	2001	2006	2011
Agriculture, Forestry, Fishing	4.1	2.9	2.5
Construction	69.1	40.0	26.5
Finance, Insur and Real Estate	29.5	19.8	16.6
Government	7.7	30.0	34.1
Manufacturing - Durable	16.8	1.3	-1.1
Manufacturing - Non-Durable	106.6	92.9	84.5
Mining	12.1	10.8	9.1
Services	153.3	107.1	98.0
Trade - Retail	96.3	67.5	58.7
Trade - Wholesale	35.9	27.4	23.2
Transport, Comm. & Public Utilities	33.8	25.6	22.6
TOTAL	**565.4**	**425.8**	**375.5**

Source: REMI Analysis by Research and Planning, MO Department of Economic Development

Table 8
Projected Wage Impacts by Sector, 2001-2011
Difference from baseline projection per 100 job increase/decrease.
Numbers may not sum due to rounding.
Adjusted to 2001 Dollars.

	WAGE CHANGE		
SECTOR	2001	2006	2011
Agriculture, Forestry, Fishing	54,990.0	46,310.0	37,610.0
Construction	2,265,000.0	1,638,000.0	1,225,000.0
Finance, Insur and Real Estate	1,226,000.0	1,007,000.0	762,900.0
Manufacturing - Durable	1,044,000.0	428,200.0	89,650.0
Manufacturing - Non-Durable	11,570,000.0	12,120,000.0	12,830,000.0
Mining	388,500.0	398,500.0	384,200.0
Services	5,093,000.0	4,227,000.0	3,986,000.0
Trade - Retail	1,659,000.0	1,367,000.0	1,120,000.0
Trade - Wholesale	1,777,000.0	1,611,000.0	1,363,000.0
Transport, Comm. & Public Utilities	1,463,000.0	1,285,000.0	1,091,000.0
TOTAL	**27,250,000.0**	**25,500,000.0**	**24,340,000.0**

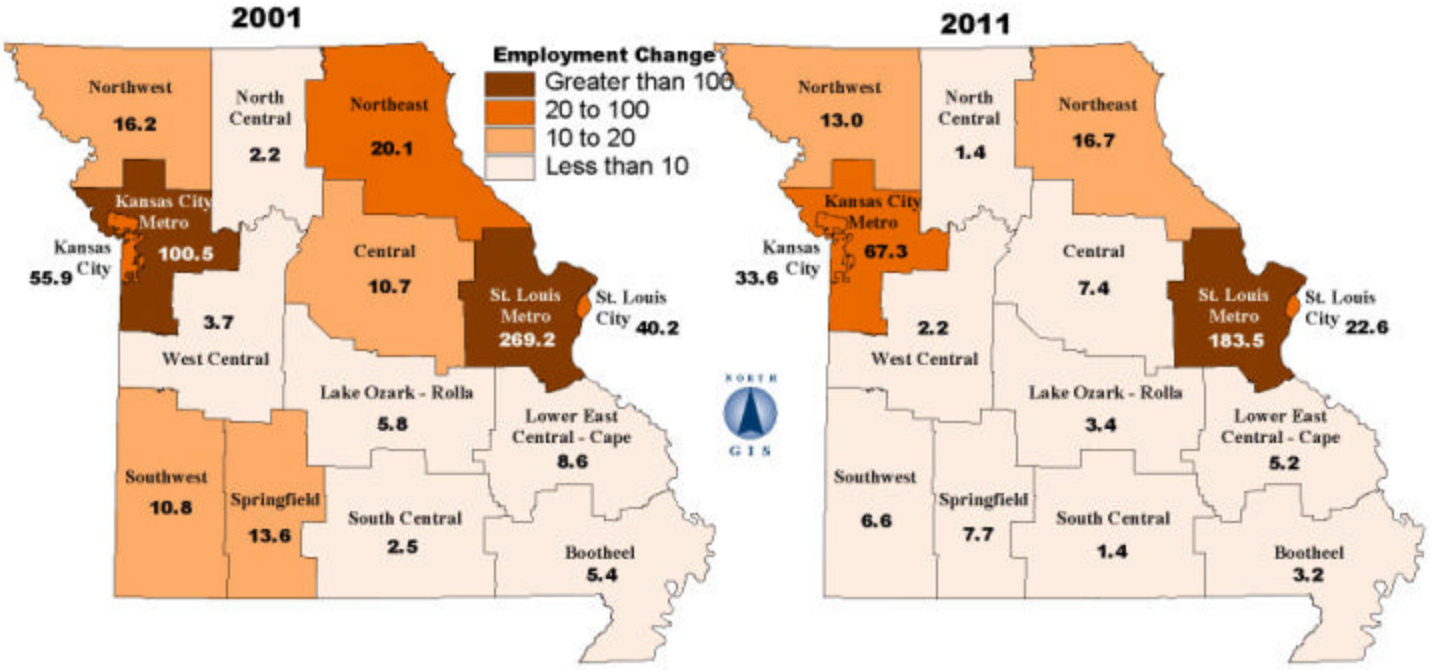
Source: REMI Analysis by Research and Planning, MO Department of Economic Development

Change in the agri-chemical industry also has differential impacts on Missouri's regional economies. In 2001, the gain/loss of 100 agri-chemical jobs in Missouri would result in the loss of 465.4 ancillary jobs in the state economy - for a total loss of 565.4 jobs and $27.3 million in wages across Missouri. By 2011, the total impact steadily drops to 375.5 jobs and $24.3 million in wages.

The St. Louis Metro Region is most impacted by changes in the agri-chemical industry, with the gain/loss of 269.2 jobs (at $58,284 per job) and $15.7 million in wages. The Kansas City Metro Region experiences the gain/loss of 100.5 jobs (at $38,876 per job) and $3.9 million wages. Lastly, Kansas City experiences the gain/loss of 55.9 jobs (at $47,943 per job) and $2.7 million wages.

In general, most other regions in the state are only moderately or marginally impacted by changes in the agri-chemical industry. Refer to Map 5 and Tables 9 and 10.

Map 5
Projected Employment Impacts by Region, 2001-2011



Source: REMI Analysis by Research and Planning, MO Department of Economic Development

Table 9
Projected Employment Impacts by Region, 2001-2011
Difference from baseline projection per 100 job increase/decrease.
Numbers may not sum due to rounding.

	EMPLOYMENT CHANGE		
REGION	2001	2006	2011
Bootheel	5.4	3.8	3.2
Central	10.7	8.5	7.4
Kansas City	55.9	38.3	33.6
Kansas City Metro	100.5	80.1	67.3
Lake Ozark - Rolla	5.8	4.1	3.4
Lower East Central / Cape Girardeau	8.6	6.1	5.2
North Central	2.2	1.6	1.4
North East	20.1	18.1	16.7
North West	16.2	14.1	13.0
South Central	2.5	1.7	1.4
South West	10.8	7.7	6.6
Springfield	13.6	9.2	7.7
St. Louis	40.2	25.3	22.6
St. Louis Metro	269.2	204.7	183.5
West Central	3.7	2.6	2.2
MISSOURI	**565.4**	**425.8**	**375.5**

Source: REMI Analysis by Research and Planning, MO Department of Economic Development

Table 10
Projected Wage Impacts by Region, 2001-2011
Difference from baseline projection per 100 job increase/decrease.
Numbers may not sum due to rounding.
Adjusted to 2001 Dollars.

	WAGE CHANGE		
REGION	2001	2006	2011
Bootheel	115,900.0	91,200.0	76,290.0
Central	318,500.0	304,200.0	276,100.0
Kansas City	2,680,000.0	2,277,000.0	1,863,000.0
Kansas City Metro	3,907,000.0	3,984,000.0	3,998,000.0
Lake Ozark - Rolla	124,500.0	104,700.0	87,260.0
Lower East Central / Cape Girardeau	247,200.0	212,900.0	175,200.0
North Central	44,820.0	39,760.0	34,150.0
North East	645,900.0	680,900.0	687,500.0
North West	386,000.0	384,700.0	358,100.0
South Central	44,880.0	38,150.0	33,380.0
South West	259,600.0	219,600.0	192,600.0
Springfield	354,800.0	295,600.0	255,100.0
St. Louis	2,322,000.0	1,822,000.0	1,474,000.0
St. Louis Metro	15,690,000.0	14,970,000.0	14,740,000.0
West Central	90,840.0	78,680.0	64,850.0
MISSOURI	**27,250,000.0**	**25,500,000.0**	**24,340,000.0**

Source: REMI Analysis by Research and Planning, MO Department of Economic Development

Occupational Impacts

The gain/loss of 100 agri-chemical jobs would affect five main occupational groups in Missouri. First, there would be a gain/loss of 98.9 Administrative Support and Clerical workers in 2001, with a 36.4% decline by 2011. This group includes administrative assistants, clerks and secretaries. Second, there would be a gain/loss of 66.5 Marketing and Sales workers in 2001, with a 36.7% decline by 2011. This group includes finance, marketing and sales workers. Third, there would be a gain/loss of 66.4 Service workers in 2001, with a 31.6% decline by 2011. This group includes food, health, personal and protective service workers. Fourth, there would be a gain/loss of 62.4 Executives and Managers in 2001, with a 35.4% decline by 2011. This group includes managers and managerial support professionals. Lastly, there would be a gain/loss of 56.8 Professional Specialty workers in 2001, with almost no decline by 2011. This group includes engineers, life scientists, physical scientists and social scientists. Refer to Table 11.

Table 11
Projected Occupational Impacts, 2001-2011
Difference from baseline projection per 100 job increase/decrease.
Numbers may not sum due to rounding.

	OCCUPATIONAL CHANGE					
	2001		2006		2011	
OCCUPATION	Number Change	Percent Change	Number Change	Percent Change	Number Change	Percent Change
Administrative Support & Clerical	98.9	0.16%	72.2	0.12%	62.9	0.10%
Agric, Forestry, Fishing	5.9	0.04%	4.1	0.03%	3.5	0.02%
Blue Collar Worker Supervisors	12.7	0.03%	9.0	0.02%	7.4	0.02%
Construction Trades	30.1	0.03%	18.2	0.02%	12.6	0.01%
Executive, Managerial	62.4	0.04%	46.5	0.03%	40.3	0.02%
Extractive Workers	2.7	0.49%	2.4	0.44%	2.0	0.40%
Hand Workers, Assembly, Fabrication	8.2	0.01%	4.3	0.01%	3.4	0.01%
Laborers, Material Movers	32.2	0.02%	22.8	0.02%	18.9	0.01%
Machine Operators & Setters	29.4	0.13%	22.4	0.08%	19.9	0.06%
Marketing, Sales	66.5	0.14%	48.4	0.10%	42.1	0.08%
Mechanics, Installers	29.3	0.09%	21.2	0.06%	17.9	0.05%
Plant & Utility Operators	4.6	0.53%	4.1	0.46%	3.7	0.42%
Production - Precision	11.2	0.12%	6.4	0.07%	5.1	0.06%
Professional Specialty	56.8	0.28%	57.1	0.23%	56.4	0.20%
Service	66.4	0.09%	49.2	0.07%	45.4	0.06%
Technicians	17.5	0.05%	13.7	0.04%	12.8	0.03%
Transportation Workers	30.7	0.11%	23.7	0.08%	20.6	0.07%
TOTAL	**565.4**	**-**	**425.8**	**-**	**375.5**	**-**

Source: REMI Analysis by Research and Planning, MO Department of Economic Development

Population Impacts

Missouri would experience a small change in population through 2011 due the gain/loss of 100 agri-chemical jobs. In 2001, Missouri would experience the gain/loss of 136.7 people, with about 45% coming from the St. Louis Metro Region. By 2011, this gain/loss expands to 589.4 people, again with about 50% coming from the St. Louis Metro Region. In short, population changes are concentrated in the St. Louis Metro Region, but also affects the Kansas City metropolitan area.

This growth in population will also generate an increased demand for public services, which leads to growth in Government sector employment. Refer to Table 12.

Table 12
Projected Population Impacts by Region, 2001-2011
Difference from baseline projection per 100 job increase/decrease.
Numbers may not sum due to rounding.

	POPULATION CHANGE		
REGION	2001	2006	2011
Bootheel	1.5	6.1	6.8
Central	2.9	10.8	11.8
Kansas City	14.0	56.5	62.7
Kansas City Metro	20.2	57.4	64.6
Lake Ozark - Rolla	2.0	7.5	8.2
Lower East Central / Cape Girardeau	3.1	12.0	13.4
North Central	0.7	2.5	2.7
North East	6.9	24.4	29.3
North West	5.7	21.1	25.4
South Central	0.6	2.4	2.5
South West	2.5	9.7	10.9
Springfield	2.7	11.1	12.3
St. Louis	9.6	35.1	38.3
St. Louis Metro	62.5	252.2	293.9
West Central	1.5	5.8	6.1
MISSOURI	**136.7**	**513.7**	**589.4**

Source: REMI Analysis by Research and Planning, MO Department of Economic Development

V. Implications and Summary

Life sciences is designated as one of Missouri's targeted industries for economic development and growth, and is actively supported by the Office of the Governor and various state agencies. The Missouri Department of Economic Development is a catalyst promoting synergies and partnerships statewide on behalf of life sciences development. Based on this initiative, Research and Planning has delineated six main life science industries: agri-chemicals, bio-medical, equipment and instruments, food and nutrition, industrial chemicals, and life sciences research. Therefore, this report examines the agri-chemical industry as a subsector of life sciences. The purpose of this analysis is to determine this industry's impact on Missouri's economy.

In 2000, agri-chemical employment was estimated at 4,569, an increase of 24.2% since 1990. Estimated annual average wages per job during 2000 in the agri-chemical industry was $117,584, an increase of 147.0% since 1990. The number of agri-chemical firms in 2000 was estimated at 59, an increase of 59.5% since 1990. In 2000, the majority of agri-chemical jobs were located in suburban St. Louis, Kansas City and St. Joseph. Additionally, agri-chemical jobs were also located in several rural areas of the state, such as Hannibal and Bowling Green.

The agri-chemical industry accounts for 1.06% of Missouri's GSP, which is equivalent to $1.78 billion dollars in 2001. The agri-chemical industry accounts for the largest percent of GRP in the Kansas City Metro Region (3.96%), the North East Region (2.38%), the St. Louis Metro Region (1.66%), and the North West Region (1.47%). However, in terms of GRP dollars the agri-chemical industry is largest in the St. Louis Metro Region ($851.5 million), the Kansas City Metro Region ($384.9 million), Kansas City ($142.5 million), and St. Louis ($122.5 million).

The direct impact of 4,569 jobs in the agri-chemical industry created an additional 21,251 ancillary jobs in Missouri's economy, resulting in a total impact of 25,820 jobs and $1.21 billion in wages across Missouri - which translates into an annual average wage per job of $46,824. Both directly and indirectly, the agri-chemical industry has the greatest impact on the Services sector, accounting for 7,009 jobs (at $33,129 per job) and $232.2 million in wages. In the Non-Durable Manufacturing sector, the agri-chemical industry accounts for 4,873 jobs (at $108,106 per job) and $526.8 million in wages. In the Retail Trade sector, the agri-chemical industry accounts for 4,390 jobs (at $17,216 per job) and $75.6 million in wages.

The St. Louis Metro Region is most positively affected by the agri-chemical industry, accounting for 12,290 jobs (at $57,404 per job) and $705.5 million in wages. In the Kansas City Metro Region, the agri-chemical industry accounts for 4,585 jobs (at $38,430 per job) and $176.2 million wages. In Kansas City, the agri-chemical industry accounts for 2,551 jobs (at $44,884 per job) and $114.5 million wages. Lastly, in St. Louis the agri-chemical industry accounts for 1,834 jobs (at $54,062 per job) and $99.2 million wages.

Both directly and indirectly, the agri-chemical industry supports five main occupational groups in Missouri. Administrative Support and Clerical workers comprise the largest occupational group, employing 4,518 people or 17.5% of the agri-chemical labor force. This group includes administrative assistants, clerks and secretaries. Marketing and Sales workers comprise the second largest occupational group, employing 3,035 people or 11.8% of the agri-chemical labor force. This group includes finance, marketing and sales workers. Service workers comprise the third largest occupational group, employing 3,033 people or 11.8% of the agri-chemical labor force. This group includes food, health, personal and protective service workers. Executives and Managers comprise the fourth largest occupational group, employing 2,848 people or 11.0% of the agri-chemical labor force. This group includes managers and managerial support professionals. Lastly, Professional Specialty workers comprise the fifth largest occupational group, employing 2,594 people or 10.1% of the agri-chemical labor force. This group includes engineers, life scientists, physical scientists and social scientists.

Life sciences is an emerging sector in the New Economy, and Missouri is well positioned to play a central role in its development. With recent discoveries in medicine and genetics, the life sciences sector will continue to play a crucial role in the economy, both in Missouri and globally. In addition to providing well paying jobs, this sector will also enhance the quality of life for citizens both within and outside Missouri.

Appendix A - Agri-Chemical Industry Definitions

Agri-Chemical Industry
by Standard Industry Classification

SIC	Description
2873	Nitrogenous Fertilizers
2874	Phosphatic Fertilizers
2875	Mixed Fertilizers
2879	Pesticides and Agricultural Chemicals

Classification scheme developed by the Missouri Department of Economic Development, in conjunction with Dr. John Houghton and members of the life sciences industry.

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